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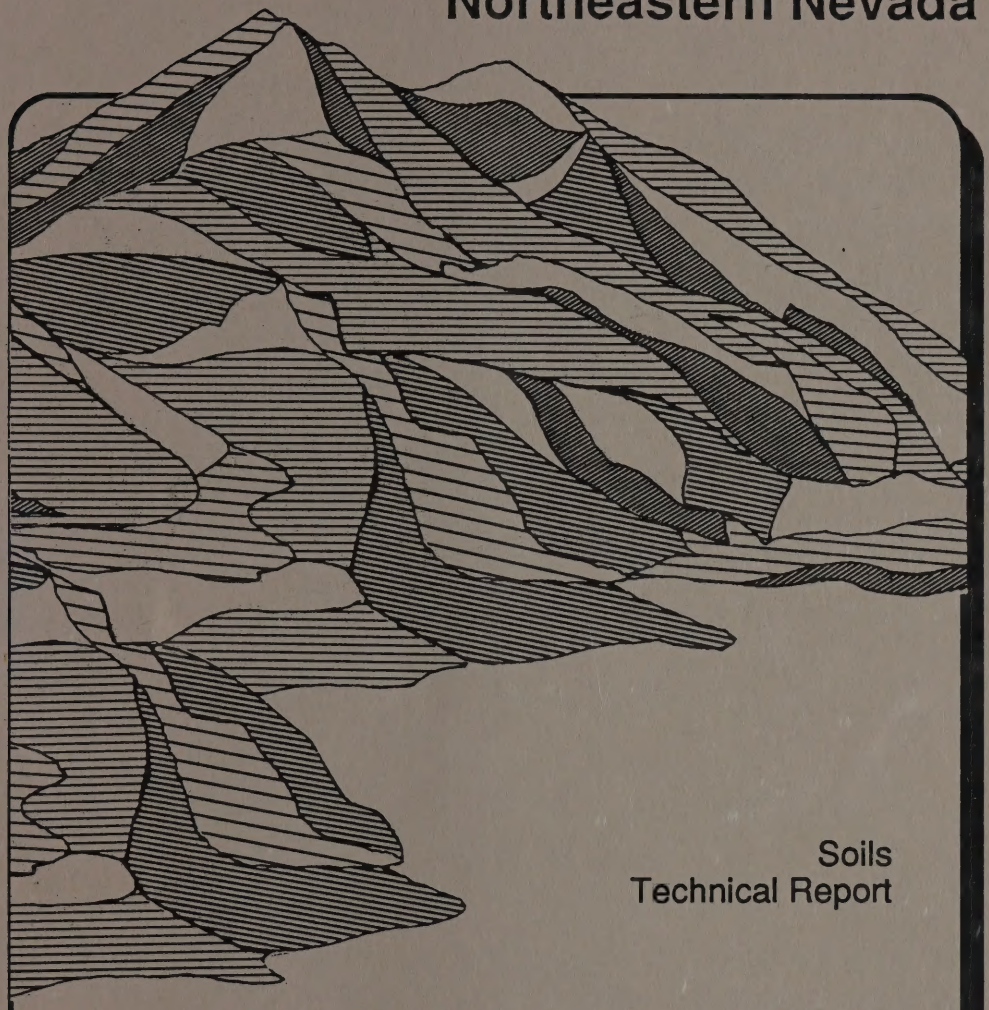
Draft Environmental Impact Statement
Thousand Springs Power Plant
Northeastern Nevada



Soils
Technical Report

U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Elko, Nevada

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1.0 INTRODUCTION

This document is the Soils Technical Report prepared as supporting documentation for the Environmental Impact Statement (EIS) for a proposed coal-fired power plant which the Thousand Springs Generating Company (TSGC) plans to construct and operate in Elko County, Nevada. TSGC is a consortium of investors. Sierra Pacific Resources is a member of the consortium and acts as project manager for the consortium. The proposed project involves a land exchange with the Bureau of Land Management (BLM) as well as construction and operation of the power plant and is called the Thousand Springs Power Plant (TSPP) project.

1.1 LAND ACQUISITION

The proposed action relative to land acquisition is to conduct a land exchange between the TSGC and the BLM. TSGC has selected approximately 15,960 acres of public lands in Toano Draw and offered, in exchange, approximately 12,770 acres of private land in the Snake Mountains and 640 acres of private land in Toano Draw.

The proposed land exchange would proceed on a surface-estate-only basis (i.e., mineral rights to the lands would not be exchanged). Existing access would be reserved to enable the BLM to continue to administer the public lands in the Toano Draw area and allow public access in all but the immediate fenced project area.

1.2 DESCRIPTION OF THE PROPOSED POWER PLANT

1.2.1 Design of the Power Plant

The TSPP electric generation complex, upon completion of development, would consist of eight 250-megawatt (MW) (nominal net) coal-fired, steam-electric generating units, designed for baseload duty but with load-cycling capability. As proposed, the TSPP would burn pulverized low-sulfur western coal, use a dry-type sulfur dioxide scrubber to conserve water, use a baghouse filter for particulate removal as the most effective available technology in conjunction with the use of low-sulfur coal, and use a counterflow cooling tower as the most favorable based on net energy efficiency, i.e., low pumping requirements, and to minimize potential freezing problems.

Major components of each power generation unit would be as follows: steam generator (boiler); turbine-generator; air emissions control systems (baghouse and dry scrubber); stack; circulating water (cooling water) system; water supply, storage, and treatment facilities; waste management and disposal facilities; fuel receiving, storage, and handling facilities; plant control systems; fire protection systems; emergency power facilities; and construction worker accommodations. Ancillary facilities for the plant as a whole would include access road, parking areas, railroad spur, switchyard, offices, warehouses, maintenance facilities, and temporary construction facilities. An 8-foot-high chainlink security fence would be provided around the main plant area. Gates would be provided at all access roads and railroad entrances.

1.2.2 Construction Worker Accommodations

On-site housing would be provided for the construction workers. Quarters would be provided for approximately 220 construction personnel. The quarters would be composed of portable or fixed buildings and could house two workers to a room with a bathroom. There would be a staffed kitchen, mess hall, laundry room, and recreation hall.

In addition, a recreational vehicle park would be constructed to accommodate approximately 300 vehicles. This park would consist of parking spaces; electrical, water, and sewer hookups; shower/toilet facilities; and a laundry building.

1.2.3 Access Road

The proposed plant access road would run from U.S. Highway 93 near Wilkins, east for approximately 4 miles along an existing county road, and then southeast to the project site. The county road would be upgraded, and approximately 10 miles of new road would be constructed from the county road southeast to the plant site at a maximum width of 100 feet. A stream-crossing culvert would be used to cross the main channel of Thousand Springs Creek. An earthen embankment would carry the road across the remainder of the floodplain. Smaller pipe culverts would be used, as required, for crossing other minor drainage channels. The access road to the plant would be fenced with a BLM-specified wire fence to prevent domestic livestock from encroaching on the road while allowing wildlife to cross. A paved parking area would be provided near the administration offices. Gravel maintenance roads would be used to service the evaporative wastewater pond and cooling tower.

1.2.4 Railroad

The Southern Pacific Railroad has a two-track line from east of the plant site that passes through Montello and Cobre to Wells. A railroad spur, to transport coal to the facility, would be constructed off of the Southern Pacific Railroad track beginning approximately 3 miles northwest of Cobre at Valley Pass and would travel northwest approximately 14 miles to the plant site with a maximum width of 200 feet. The spur would be constructed with two short tracks from Southern Pacific Railroad's dual track, to allow ingress and egress to and from the plant site. The

railroad spur, unloading loop, and switchyard would be designed and constructed in conformance with railroad standards. The railroad spur to the plant site would be wire-fenced, using BLM specifications. The loop would be designed so that two unit trains could unload coal simultaneously.

1.2.5 Construction of the Power Plant

The proposed power plant, upon completion of development, would consist of eight 250-MW coal-fired, steam-electric generating units. Construction of the first unit is described here in terms of the following seven overlapping phases:

1. Access road construction and site preparation
2. Construction of internal access and utility network
3. Construction of plant facilities (housing, shops, fire pumphouse, etc.)
4. Concrete foundation installation
5. Structural steel erection
6. Major equipment and main building erection
7. Piping, electrical connection, and instrumentation installation

Construction of the first unit is scheduled to commence in early 1991 and be completed in late 1994. Commercial operation of this unit is anticipated in late 1994. The timing for implementation of each phased unit would be dictated by market demand for electrical power. Construction of additional generating units would require about 34 months each and would overlap with the preceding unit by 10 months. This would allow for an efficient transition of resources from unit to unit.

The first peak of construction personnel is anticipated to be 805 workers in 1993, associated with construction of Units 1 and 2. The average workforce during that year is anticipated to be approximately 500. A second workforce peak is anticipated between the completion of the fourth and fifth units in 2000.

Site clearing, grading, and surfacing would be confined to those areas which are to be built upon or utilized during construction, or which are part of the ash disposal area. Site clearing would be conducted on an "as-required basis," and individual areas would be cleared just prior to construction startup. Vegetation that requires removal would be disposed of on site in a Class III disposal site. In total, approximately 1780 acres of land would be disturbed upon completion of development of the power plant and ancillary linear facilities.

1.2.6 Operation of the Power Plant

The proposed action for the power plant operation involves a baseload power plant, operating 24 hours a day, 365 days per year. The plant would operate using three 8-hour workshifts. The operational workforce would be approximately 145 persons, for each pair of units, or 564 operation workers upon completion of all eight units. Each unit would be designed to operate for 35 years with the first unit beginning operation in 1994 and the eighth unit ending operation in 2043.

Coal would be delivered to the plant site by unit trains. The coal would be produced from mines at Kemmerer, Wyoming, and Scofield, Utah. Each mine would supply coal in an amount equal to 50 percent of the heat input to the generating units. Coal would be delivered along a new railroad spur laid earlier between the Southern Pacific Transportation Company's main line at Valley Pass and the plant site. The new spur would be constructed and maintained by TSGC.

The turbine-generator of each unit would have a nominal gross (nameplate guarantee) rating of 267,521 kilowatts (kW), which would yield a net output of 250,000 kW. The maximum gross generating capability (maximum load) for each unit would be 292,666 kW with the control valves wide open, and steam at 5 percent overpressure (above the nominal design pressure).

The estimated normal average load factor for a unit would be 85.8 percent for the first 5 years of operation. The load factor would progressively decrease to an estimated 53.2 percent in the 31st year of operation and thereafter. The average load factor for each unit over its expected 35 years of operation would be about 75 percent.

The air emissions control system would reduce the stack gas emissions of particulate matter (fly ash) and sulfur dioxide (SO_2) to below the regulatory prescribed maximum. The control system would include a lime spray dryer scrubber system to remove sulfur oxides (SO_x) and a fabric filter to remove particulates. Generation and emission of nitrogen oxides (NO_x) would be controlled by design and control of the combustion process within the furnace.

Water, for use in generating steam and for transferring plant-generated waste heat to the atmosphere, would be obtained from wellfields in the Thousand Springs drainage basin. The wellfield to supply three generating units would be located in Toano Draw Subbasin, where the power plant would be located. For the other five units, it is expected that one or more wellfields would be developed along the lower reaches of Thousand Springs Creek in the vicinity of Gamble Ranch. The estimated maximum plant water requirement is 4000 ac-ft/yr per generating unit, or 32,000 ac-ft/yr upon completion of plant development.

Evaporative waste ponds, approximately 10 feet in depth, would be provided for storage and disposal of liquid wastes for the life of the plant. The ponds would receive all non-reusable liquid wastes, such as coal pile runoff, cooling tower blowdown, ash system blowdown, sanitary waste, and wastewaters from chemical cleaning, intermittent boiler cleaning, and equipment washroom. The preliminary design concept for the evaporation ponds includes a double-liner system utilizing a leak detection system and inspection wells.

1.3 DESCRIPTION OF ALTERNATIVES

In addition to the proposed action, several alternatives were identified. The alternatives considered in this analysis are grouped into five categories: power generation alternatives, site alternatives, project component alternatives, land acquisition alternatives, and no action alternative. Table 1-1 summarizes all project component alternatives considered and those selected for analysis.

The remainder of this report is organized as follows: Section 2.0 describes the affected environment, and Section 3.0 discusses the environmental consequences.

Table 1-1. SUMMARY OF ALTERNATIVES CONSIDERED AND THOSE SELECTED FOR ANALYSIS

Project Component	Proposed Action	Alternatives Considered	Alternatives Selected for Analysis
Power Generation	Eight 250-MW coal-fired units	Solar Wind Nuclear Fusion Geothermal Hydroelectric Solid Waste Cogeneration Oil or Natural Gas Nuclear Fission	No Action
		No Action	
Site	Toano Draw	Nine Candidate Site Regions Throughout the State	Analyzed in Regional Site Evaluation/ Selection Study (WCC 1980)
Access Road	Off of Highway 93 near Wilkins	Moor Summit Off Interstate 80	Moor Summit
		Brush Creek Off of U.S. Highway 93 3.5 Miles South of Wilkins	Brush Creek
Railroad	Off of Southern Pacific near Cobre	Off of Union Pacific near Wells Paralleling U.S. Highway 93	None due to grade constraints
Construction-Worker Accommodations	On-site Construction-Worker Camp and RV Park	Construction-Worker Camp and RV Park Near Cobre	No Construction-Worker Camp
		Construction-Worker camp and RV Park Near Wilkins	
		No Construction-worker camp	

Table 1-1. SUMMARY OF ALTERNATIVES CONSIDERED AND THOSE SELECTED FOR ANALYSIS (continued)

Project Component	Proposed Action	Alternatives Considered	Alternatives Selected for Analysis
Cooling System	Mechanical Draft Cooling Towers	Natural Draft Cooling Towers	Not analyzed due to high temperatures and low humidity levels in project area
		Cooling Ponds	Not analyzed due to large land requirements and high water loss
		Dry Mechanical Draft Cooling Towers	Not analyzed due to large land requirements and reduced efficiency
		Wet/Dry Towers	Not analyzed due to large land requirements
Water Supply	Wellfield for 3 Units South of Plant Site in Toano Draw; Wellfield for 5 Units in Gamble Ranch Vicinity	Wellfield for 2 Units South of Plant Site in Toano Draw; Wellfield for 1 Unit North of Plant Site in Toano Draw; Wellfield for 5 Units in Gamble Ranch Vicinity	Wellfield for 2 Units South of Plant Site in Toano Draw; Wellfield for 1 Unit North of Plant Site in Toano Draw; Wellfield for 5 Units in Gamble Ranch Vicinity
		Wellfield for 2 Units South of Plant Site in Toano Draw; Wellfield for 6 Units in Gamble Ranch Vicinity	Wellfield for 2 Units South of Plant Site in Toano Draw; Wellfield for 6 Units in Gamble Ranch Vicinity

Table 1-1. SUMMARY OF ALTERNATIVES CONSIDERED AND THOSE SELECTED FOR ANALYSIS (continued)

Project Component	Proposed Action	Alternatives Considered	Alternatives Selected for Analysis
Oxides of Nitrogen Control	Low-NO_x burner with combustion modification	Selective Catalytic Reduction with Ammonia	Not analyzed due to lack of commercial demonstration of adequacy on utility size coal-fired boiler
		Noncatalytic Reduction with Ammonia	Same as above
		Noncatalytic Reduction with Urea	Same as above
		Low-NO_x Burner	Less efficiency than low-NO_x burners with combustion modification
		Flue Gas Recirculation	Same as above
		Fluid Bed Combustion	Not analyzed due to high water consumption
Sulfur Dioxide Control	Lime Spray Dryer	Wet Scrubber	Not analyzed due to high water consumption
		Fluid Bed Combustion	Not analyzed due to lack of commercial demonstration of adequacy
		Limestone Injection into Furnace	Not analyzed due to low control efficiency

Table 1-1. SUMMARY OF ALTERNATIVES CONSIDERED AND THOSE SELECTED FOR ANALYSIS (concluded)

Project Component	Proposed Action	Alternatives Considered	Alternatives Selected for Analysis
		Dry Lime Injection into Duct	Not analyzed due to low control efficiency, and lack of commercial demonstration of adequacy
Particulate Matter Control	Baghouse	Electrostatic Precipitator (ESP)	Not analyzed as a baghouse system is strongly preferred for use with lime spray dryer for SO_2 control
		Carbon Monoxide Catalysts	
Land Acquisition	Land Exchange	Right-of-Way Grants	Right-of-Way Grants
		Selling the Public Lands	Selling the Public Lands
		No Action	No Action

2.0
AFFECTED ENVIRONMENT

Soil represents an important link between the physical and biological worlds, as it provides the basis for vegetation growth and terrestrial life. Soil is also important because of its influence on the success and feasibility of various construction activities. Certain soil types can pose difficult problems or limitations to proposed project actions and, in turn, can be more sensitive to the effect of these actions. The soil types located in the project study area are discussed in more detail below.

2.1 STUDY AREA DEFINITION

For the purpose of this discussion, the project is divided into two main study areas:

1. Study Area No. 1 - Lands involved in the proposed land exchange, including the private lands offered to the Bureau of Land Management (BLM) and the selected lands to be obtained from the BLM for some project utility corridors (Figure 2-1).

   With the exception of the areas involved in the construction of the proposed utility corridors and plant site, the land exchange study area soils would not receive direct impacts from project construction and operation.

2. Study Area No. 2 - Plant site area (approximately 1240 acres) and proposed ancillary linear facilities (approximately 540 acres) (Figure 2-2).

   These lands include portions of the selected lands, as well as other sections already in private ownership. Construction and operation of the proposed facilities would directly affect the plant site area and those portions of the utility corridors actually disturbed by construction activities.

Information on soils in these study areas was obtained from a number of unpublished soil survey documents and maps, authored by the U.S. Department of Agriculture - Soil Conservation Service (SCS) and provided by the Elko District Office of the BLM. The documents include descriptions and interpretations for various soil associations found within the study areas, with locations of these associations outlined on 7½-minute quad maps. This information was reviewed to identify soil characteristics which could be of

significance in relation to construction and operation of the proposed power plant and ancillary facilities. These soil characteristics include:

- Slope
- Water and wind erosion potential (as interpreted by the SCS, taking into account inherent soil characteristics, slope, climatic factors)
- Reclamation potential (as indicated by the SCS rating of topsoil conditions and rangeland seeding potential, a conservative approach since the topsoil rating is usually applied to suitability for home/garden use)
- Potential for road-building problems (as indicated by the SCS interpretation, which takes into account such factors as presence of hardpan, stones, soil depth, strength, shrink/swell characteristics, and frost action)
- Potential for construction/excavation problems (as indicated by the SCS interpretation, which takes into account such factors as soil depth, stones, cutbank stability, and hardpan)

The latter two characteristics (roadbuilding and construction/excavation suitability) include limitations that do not preclude development, but often require changes in design or additional mitigation that could result in increased cost.

Only a general description of the soil associations is provided for Study Area No. 1. This is because the soils would either not be directly affected by construction, or, in the case of those specific locations included within the proposed project facility sites, the soil types are discussed under Study Area No. 2. For Study Area No. 2, tables are provided which give specific information on the soil characteristics for each soil type affected by a proposed project facility. Tables 2-1 through 2-6 also indicate the approximate percentage of the route or, in the case of the power plant site itself, approximate acreages, within the indicated soil type. A single table for the power plant site and individual tables for each of the utility corridors (proposed access road, railroad, water pipeline, alternative access roads) are provided. These tables form the basis for determining areas of potential impact.

2.1.1 Study Area No. 1 - Land Exchange Areas

With the exception of one section of land northeast of the plant site, the offered lands are located within an area of the Snake Mountain Range and associated alluvial fans to the east. Several small creeks or draws originate in the mountains and drain east through the offered lands. The upland areas include the summit of Loomis Mountain.

R61E R62E R63E R64E R65E R66E

T 41 N

T 40 N

T 39 N

T 38 N

T 37 N

WILKINS

TOANO DRAW

SNAKE MOUNTAINS

WINDERMERE HILLS

WELLS

MOOR SUMMIT

OASIS

0 3 6

miles

LEGEND

Selected Lands (Public)

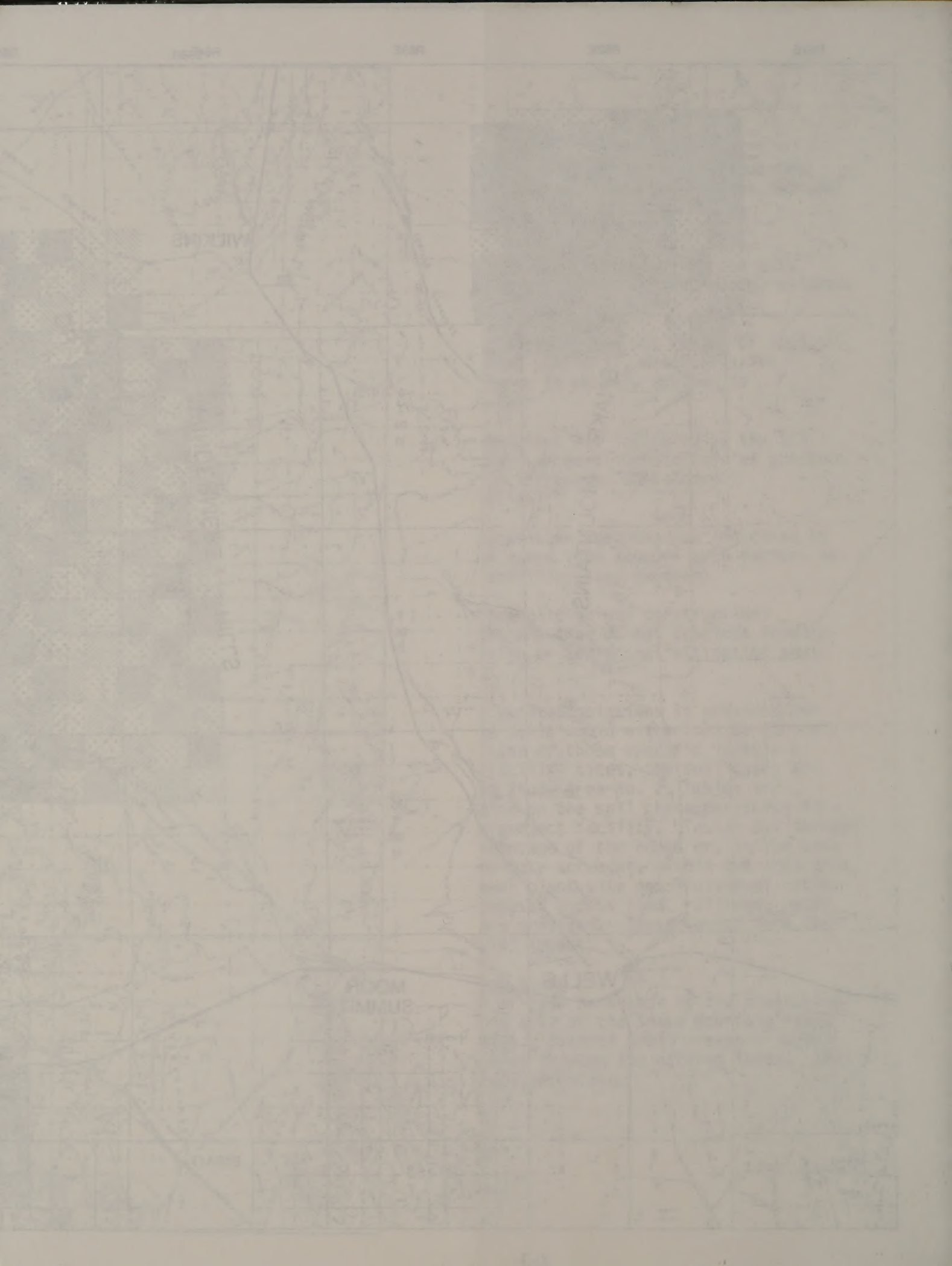
Offered Lands (Private)

Land Status in the Vicinity of Exchange Lands

Public Lands (BLM)

Patented Lands (Private)

Figure 2-1. LOCATION OF SELECTED AND OFFERED LANDS



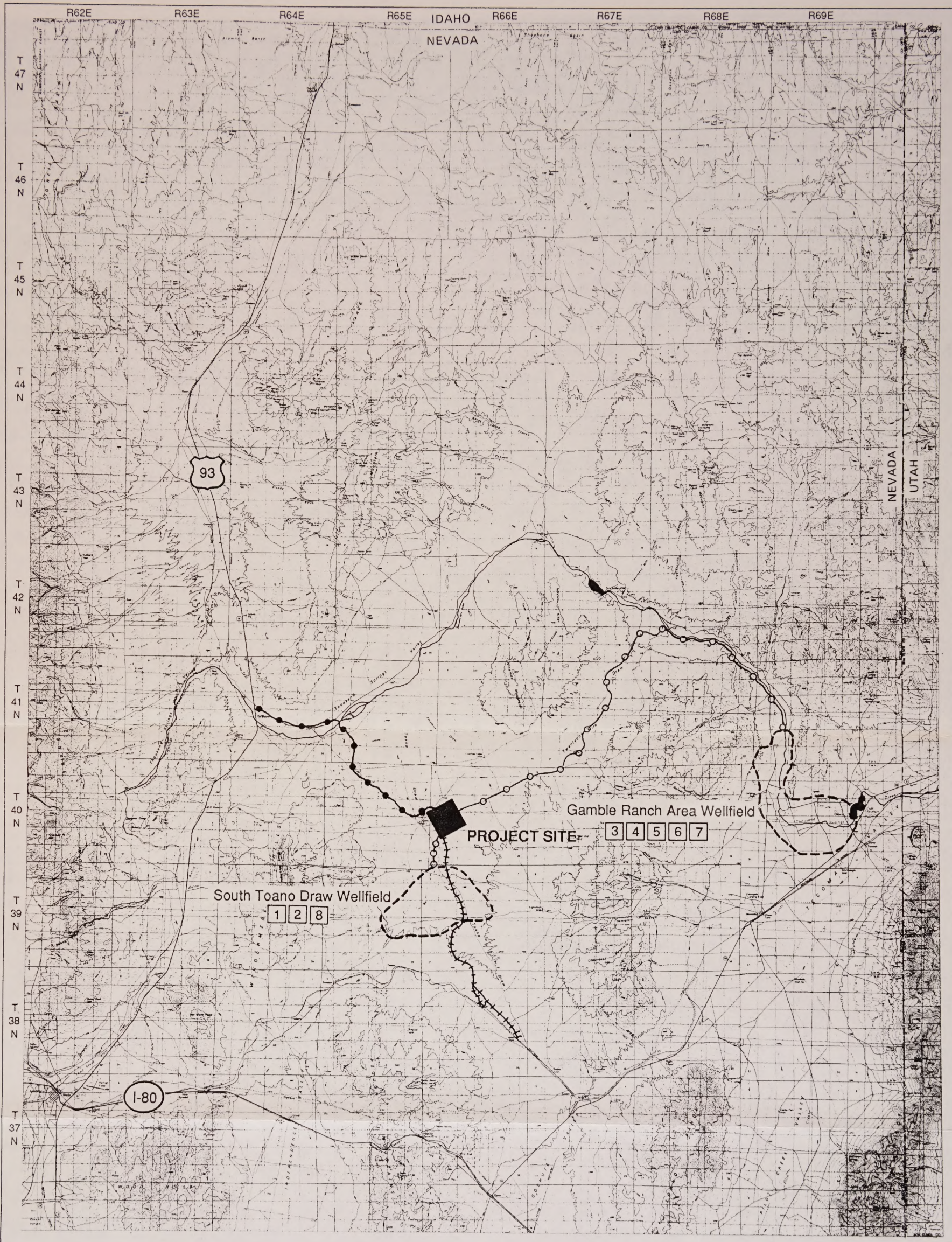


Figure 2-2. LOCATION OF PROPOSED POWER PLANT AND ANCILLARY FEATURES

Because these soils would not be disturbed or directly affected by project construction, the various soil associations were not quantified. The following discussion gives a qualitative description of the dominant soil types in this area.

The mountain tops and slopes possess soils that are moderately steep to very steep, shallow to deep, and well-drained. The Cleavage soil series is extremely common and is the dominant soils series for four of the major soil associations found in the mountain area. In addition, there are also large areas of Tusel-Belsac Association soils and Gollaher-Hackwood soils. All of these soils are very gravelly, stoney, or cobbly loams or silt loams, and are derived from apparent material consisting of colluvium or residuum from various rock sources. Slopes range from 4 percent on lower hills up to 75 percent, with 15 to 50 percent slopes being the most frequently reported. Several areas have moderate to high water erosion potential, and all the predominant soils exhibit characteristics that make any construction activity extremely difficult to perform or to mitigate (stones, gravel, shallow depth, etc.).

The piedmont or alluvial fan area east of the Snake Mountain Range consists of gently sloping to steep, shallow to deep, well-drained soils, most of which are alluvial deposits. The most common soil associations in this portion of Study Area No. 1 are two Donna series associations and the Chen-Coser Association. All these soils are gravelly loams, with slopes ranging from 2 to 15 percent, and generally have poor topsoil conditions. A cemented hardpan occurs in Donna series soil at a depth of about 2 to 3 feet.

The one section of offered land located to the northeast of the proposed power plant site consists primarily of a Cobre series-dominated association. This is a gently sloping silt or gravelly loam, with fair to poor topsoil characteristics, found on the slopes. Also, a small portion of a draw in this section contains a mixed alluvial deposit, a silt loam with very slight slopes, and generally fair topsoil conditions.

The selected lands comprise the other portion of this study area. Because these lands follow the linear patterns of the proposed utility corridors, they cover a large geographic area and include a wide range of geological, topographic, vegetative, and climatic conditions, and therefore, a wide range of soil types. These soil types are found within the lands that would be directly affected by the proposed access road, alternate access roads, and railroad construction. They are discussed in greater detail as part of the Study Area No. 2 section. For purposes of the qualitative comparison with the offered lands, the following general description of the selected lands is provided:

- Section along the proposed railroad corridor - this section contains large sections of soils of the Chiara and Peeko series, and also the Wiffo-Nevador Association. All of these soil types are gently to strongly sloping, well-drained, and located on fan

piedmont remnants. The Chiara and Peeko soils have a cemented pan; all sections have generally fair to poor topsoil conditions and seeding potential.

- Section along the proposed access road route - this section consists of gently to strongly sloping, well-drained soils on fan skirts and piedmont fan remnants (Peeko series, Wiffo-Nevador Association). There is also a relatively large area of Valmy soil series associations, which are generally fine silt loams, found along floodplains and stream terraces, plus some additional Toano series floodplain soils. These latter two soil types are found along the various streams in the area and generally have better topsoil, better seeding potential, and very slight slopes.

- Section along Moor Summit alternative access road route - this section covers the greatest variety of soil types, because of its length and the diverse topography found along the route. Associations with the largest representation along this corridor include the Peeko, Chiara, and Wiffo-Nevador soils discussed above, plus associations containing the Gochea soil series. The Gochea soils are gravelly silt loams found along valley fans and piedmont remnants. Other types of soils, including very steep, cobbly soils, and floodplain deposits, are also represented along this route.

- Section along Brush Creek alternative access road route - this section consists of about one-third arid and stony cemented hardpan. Another large portion, approximately one-half of the route, consists of Wiffo-Nevador and Valmy-Enko soils, which are also stony and arid or droughty. The Hundraw Association (approximately 16 percent of the route) may present some slopes and has a shallow depth to rock. A few small segments pass over stream floodplains, which are generally better soils, although the Sonoma Association in Brush Creek Valley is known for flooding and excess salts.

2.1.2 Study Area No. 2 - Plant Site and Ancillary Linear Facility Corridors (Proposed and Alternative Access Roads, Railroad, Water Pipeline)

Soils of this study area would be directly affected by the proposed project activities and would also pose certain limitations or problems for construction of facilities. Tables 2-1 through 2-6 present a description of the affected environment soils in a tabular format, with emphasis on those soil characteristics that would play important roles in determining both impacts and construction limitations. Generally, nearly all of the Study Area No. 2 soils exhibit problems with reclamation potential because of poor topsoil conditions and/or poor rangeland seeding potential. Only a few are considered "good" seeding base soils, but these still have "poor" topsoil conditions, which, from a conservative viewpoint, may present limitations to successful reclamation planting. In addition, most of the soils identified exhibit characteristics which indicate potential problems

with either roadbuilding or construction (shallow excavation), such as the presence of stones, cemented pan, low strength, high shrink/swell potential, cutbank instability, or steep slopes. These limitations do not preclude development, but may result in design or mitigation plans that are more costly. A few soils have high water erosion potential, as determined by their inherent characteristics and slope, although most are considered to have only a slight or moderate water erosion potential. None of the soils exhibit any more than a slight wind erosion potential. Slopes for these soils range from 0 to 2 percent for floodplain locations to greater than 40 percent in some hilly and mountainous areas. The piedmont fan soils generally have gentle to moderate slopes in the 8 to 15 percent range.

Table 2-1. CHARACTERISTICS OF SOILS IDENTIFIED WITHIN PROPOSED POWER PLANT SITE AREA

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Wiffo-Nevador Assoc. (#175): Gently to strongly sloping, well-drained soils; on alluvial fan skirts	• Dominant soil type for plant site, esp. western half	Wiffo-50%	GRV-L	2-8	Slight	Slight	Poor - Droughty, stones, poor topsoil*	Moderate-frost action, large stones	Severe-cutbanks cave*
	• ~1075 acres included within fenced area	Nevador-35%	L	2-8	Slight	Slight	Fair-poor-arid stones*	Moderate-frost action	Severe-cutbanks cave*
	• The most likely soil type affected by solid waste landfills sites								
Toano-Tulase Assoc. (#2081): Level to gently sloping, deep, generally well-drained soils; on stream terraces	• Found in a few flood plain areas traversing site; largest area in center, within fenced zone	Toano-55%	SIL	0-2	Slight	Slight	Fair to Poor-thin, arid soils, crusty*	Moderate	Slight
	• ~150 acres included within fenced area	Tulase-30%	VFSL	0-2	Slight	Slight	Fair - arid	Moderate	Slight
	• Some affected by landfill sites								

Table 2-1. CHARACTERISTICS OF SOILS IDENTIFIED WITHIN PROPOSED POWER PLANT SITE AREA (concluded)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Zappa-Peeko-Oupico Assoc. (#404): Gently to strongly sloping, moderately deep to deep, well-drained soils on alluvial fan piedmont remnants	• In hilly piedmont area on eastern side of site	Zapa-35%	GRV-SIL	2-8	Slight	Slight	Poor-stones*	Moderate	Severe-cemented pan*
	• ~75 acres included at edges of fenced area	Peeko-25%	SIL	4-15	Slight	Moderate	Poor-pan, stones, arid*	Severe - pan*	Severe-pan*
	• Least likely to be greatly affected by proposed landfill sites	Oupico-15%	L	2-8	Slight	Slight	Fair to Poor-stones, arid*	Moderate	Severe-pan*

Table 2-2. CHARACTERISTICS OF SOILS IDENTIFIED ALONG PROPOSED ACCESS ROAD ROUTE

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Wiffo-Nevador Assoc. (#175): Gently to strongly sloping, well-drained soils; on alluvial fan skirts	47 (approx ½ of this follows existing road)	Wiffo-50%	GRV-L	2-8	Slight	Slight	Poor-droughty, stones poor topsoil*	Moderate-frost action, large stones	Severe-cutbanks, cave*
		Nevador-35%	L	2-8	Slight	Slight	Fair to Poor-arid, stones*	Moderate-frost action	Severe-cutbanks, cave*
Dewar-Hunnton-Gance Assoc. (#131): Gently to strongly sloping, well-drained soils; shallow to cemented pan; on fan piedmont remnants	6 (nearly all follows existing road)	Dewar-40%	GRV-SIL	2-8	Slight	Slight	Poor-cemented pan, small stones, droughty*	Severe-cemented pan*	Severe-cemented pan*
		Hunnton-30%	GR-L	2-8	Slight	Slight	Fair to Poor-small stones, arid*	Severe-low strength, high shrink/ swell*	Severe-cemented pan, cutbanks, cave*
		Gance-15%	GRV-L	15-30	Slight	Moderate	Poor-stones, slope*	Severe-slope*	Severe-slope*
Devilsgait-Valmy Assoc. (#483): Relatively level, very deep, well-drained soils; on floodplains and stream terraces	7	Devilsgait-50%	SIL	0-2	Slight	Slight	Moderate-wetness	Severe-low strength, wetness*	Severe-cutbanks cave, wetness*
		Valmy-35%	FSL	2-4	Slight	Slight	Poor-small stones, crusty*	Slight	Severe-cutbanks cave*

Table 2-2. CHARACTERISTICS OF SOILS IDENTIFIED ALONG PROPOSED ACCESS ROAD ROUTE (concluded)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Valmy-Enko Assoc. (#590): Gently to strongly sloping, well-drained soils; on alluvial fan skirts adjacent to both floodplains and alluvial fan piedmonts	12	Valmy-55%	FSL	0-2	Slight	Slight	Poor-stones, crusty*	Moderate-frost action	Severe-cutbanks cave*
		Enko-30%	FSL	2-4	Slight	Slight	Fair-stones, arid	Moderate-frost action	Slight
Peeko-Oupico-Dewar Assoc. (#123): Gently to strongly sloping, well-drained soils; on crests and slopes of alluvial fan piedmont remnants	23	Peeko-50%	SIL	2-8	Slight	Moderate	Poor-arid, cemented pan, stones*	Severe-cemented pan*	Severe-cemented pan*
		Oupico-20%	L	2-8	Slight	Slight	Fair to Poor-arid, stones*	Moderate-pan, frost	Severe-pan*
		Dewar-15%	GR-SIL	2-4	Slight	Slight	Poor-droughty, pans, stones*	Severe-pan*	Severe-pan*
Toano-Tulase Assoc. (#2081): Level to gently sloping, deep generally well-drained soils; on stream terraces, inset alluvial fans, and their margins	5	Toano-55%	SIL	0-2	Slight	Slight	Fair to Poor-thin, arid soils, crusty*	Moderate	Slight
		Tulase-30%	VFSL	0-2	Slight	Slight	Fair-arid	Moderate	Slight

Table 2-3. CHARACTERISTICS OF SOILS IDENTIFIED ALONG PROPOSED RAILROAD ROUTE

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Peeko-Chiara Assoc. (#127): Gently sloping to moderately steep; shallow, cemented pan, well-drained soils in alluvial fan piedmont remnants	21	Peeko-50%	SIL	2-8	Slight	Slight	Poor-arid, pan, stones*	Severe-pan*	Severe-pan*
		Chiara-35%	SIL	2-8	Slight	Moderate	Fair to Poor-pan, arid*	Severe-pan*	Severe-pan*
Dewar-Chiara-Hunnton Assoc. (#133): Gently to strongly sloping, well-drained soils, shallow to cemented pan on alluvial fan piedmont remnants	22	Dewar-40%	GR-SIL	2-8	Slight	Slight	Poor-pan, stones droughty*	Severe-pan*	Severe-pan*
		Chiara-30%	SIL	2-8	Slight	Moderate	Fair to Poor-pan, stones, arid*	Severe-pan*	Severe-pan*
		Hunnton-15%	GR-L	2-8	Slight	Slight	Fair to Poor-stones arid*	Severe-low, strong, shrink/ swell*	Severe-pan cutbanks-cave*
Peeko-Zapa Assoc. (#126): Gently to strongly sloping, well-drained soils on alluvial fan piedmont remnants	7	Peeko-45%	SIL	2-8	Slight	Slight	Poor-pan, stones arid*	Severe-pan*	Severe-pan*
		Zapa-40%	GRV-SIL	8-15	Slight	Moderate	Poor-stones*	Moderate	Severe-pan*

Table 2-3. CHARACTERISTICS OF SOILS IDENTIFIED ALONG PROPOSED RAILROAD ROUTE (continued)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Hundraw-Anowell-Peeko Assoc. (#940): Gently to strongly sloping, shallow, well-drained soils; on alluvial fan piedmont remnants	17	Hundraw-50%	GR-L	15-50*	Slight	Moderate	Poor-arid, droughty, shallow, stones*	Severe-slope*	Severe-slope shallow*
		Anowell-20%	GR-L	8-30	Slight	Moderate	Poor-arid, droughty, shallow, stones*	Severe-slope*	Severe-slope shallow*
		Peeko-15%	SIL	4-15	Slight	Slight	Poor-pan, stones, arid*	Severe-pan*	Severe-pan*
Toano-Tulase Assoc. (#2081): Level to gently sloping, deep generally, well-drained soils; on stream terraces, inset alluvial fans, and their margins	9	Toano-55%	SIL	0-2	Slight	Slight	Fair to Poor-thin, arid, crusty*	Moderate	Slight
		Tulase-30%	VFSL	0-2	Slight	Slight	Fair-arid	Moderate	Slight
Wiffo-Nevador Assoc. (#175): Gently to strongly sloping, well-drained soils; on alluvial fan skirts	17	Wiffo-50%	GRV-L	2-8	Slight	Slight	Poor-droughty, stones, poor topsoil*	Moderate frost action, large stones	Severe-cutbanks cave*
		Nevador-35%	L	2-8	Slight	Slight	Fair to Poor-arid stones*	Moderate frost action	Severe-cutbanks cave*

Table 2-3. CHARACTERISTICS OF SOILS IDENTIFIED ALONG PROPOSED RAILROAD ROUTE (concluded)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Chiara-Dowar-Enko Assoc. (#144): Gently sloping, shallow, cemented pan, well-drained soils on alluvial fan piedmont remnants	7	Chiara-35%	SIL	2-4	Slight	Moderate	Fair to Poor pan, arid*	Severe-pan*	Severe-pan*
		Dewar-25%	GR-SIL	2-4	Slight	Slight	Poor-pan, stones, Droughty*	Severe-pan*	Severe-pan*
		Enko-25%	FSL	2-4	Slight	Slight	Fair	Moderate	Slight

Table 2-4. CHARACTERISTICS OF SOILS IDENTIFIED ALONG PROPOSED WATER PIPELINE ROUTE

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Izar-Dewar-Izar Moderately Steep Assoc. (#679): Gently sloping to steep, shallow, well-drained soils; on low mountains, hills, and summits of alluvial fan piedmont remnants	11	Izar-30%	GRV-L	4-15	Slight	Slight	Poor-droughty, stones, shallow*	Severe-shallow*	Severe-shallow*
		Dewar-30%	GR-SIL	2-8	Slight	Slight	Poor-droughty, pan, stones*	Severe-cemented pan*	Severe-pan*
		Izar-Mod. Steep-25%	GRV-L	15-30	Slight	Moderate	Poor-shallow, stones, droughty slope*	Severe-slope, shallow*	Severe-slope, shallow*
Toano-Tulase Assoc. (#2081): Level to gently sloping, deep generally, well-drained soils; on stream terraces, inset alluvial fans, and their margins	40	Toano-55%	SIL	0-2	Slight	Slight	Fair to Poor-thin, arid soils, crusty*	Moderate	Slight
		Tulase-30%	VFSL	0-2	Slight	Slight	Fair - arid	Moderate	Slight
Tecomar-Kram-Amtoft Assoc. (#3012): Moderately sloping to steep, shallow, well-drained soils on mountain slopes	2	Tecomar-40%	STX-SIL	15-50*	Slight	High*	Poor-shallow, stones droughty*	Severe-shallow, stones, slope*	Severe-shallow, large stones, slope*
		Kram-30%	GRV-L	15-50*	Slight	Moderate	Poor-shallow, stones droughty*	Severe-shallow, stones, slope*	Severe-shallow, large stones, slope*
		Amtoft-20%	STX-L	15-50*	Slight	Moderate	Poor-shallow, stones droughty*	Severe-shallow, stones, slope*	Severe-shallow, large stones, slope*

Table 2-4. CHARACTERISTICS OF SOILS IDENTIFIED ALONG PROPOSED WATER PIPELINE ROUTE (continued)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Cobre-Hundraw-Jackpot Assoc. (#3031): Gently sloping to steep, shallow to deep, well-drained soils on hills, sideslopes	10	Cobre-50%	SIL	4-15	Slight	Moderate	Fair-thin, arid	Moderate-frost	Moderate-shallow
		Hundraw-20%	GRV-FSL	8-30	Slight	Moderate	Poor-shallow, stones, arid*	Severe-slope*	Severe-shallow, slope*
		Jackpot-15%	SL	15	Slight	Slight	Fair to Poor-shallow, arid*	Moderate-shallow, frost	Severe-shallow*
Cobre-Hundraw-Anowell Assoc. (#3032): Gently sloping to steep, shallow to deep, well-drained soils on hills, sideslopes	28	Cobre-35%	SIL	2-8	Slight	Slight	Fair-thin, arid	Moderate	Moderate
		Hundraw-35%	GR-L	2-8	Slight	Slight	Poor-shallow, stones, arid*	Moderate	Poor-shallow*
		Anowell-15%	GR-L	8-30	Slight	Moderate	Poor-droughty, shallow, stones, slope*	Severe-slope*	Severe-shallow, slope*
Zapa-Pecko-Oupico Assoc. (#404): Gently to strongly sloping, moderately deep, well-drained soils; on alluvial fan piedmont remnants	3	Zapa-45%	GRV-SIL	2-8	Slight	Slight	Poor-stones*	Moderate	Severe-cemented pan*
		Pecko-25%	SIL	4-15	Slight	Moderate	Poor-pan, stones, arid*	Severe-pan*	Severe-pan*
		Oupico-15%	L	2-8	Slight	Slight	Fair to Poor-stones, arid*	Moderate	Severe-pan*

Table 2-4. CHARACTERISTICS OF SOILS IDENTIFIED ALONG PROPOSED WATER PIPELINE ROUTE (concluded)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Wiffo-Nevador Assoc. (#175): Gently to strongly sloping, well-drained soils; on alluvial fan skirts	6	Wiffo-50%	GRV-L	2-8	Slight	Slight	Poor - Droughty, stones, poor topsoil*	Moderate frost action, large stones	Severe-cutbanks cave*
		Nevador-35%	L	2-8	Slight	Slight	Fair to Poor-arid stones*	Moderate frost action	Severe-cutbanks cave*

Table 2-5. CHARACTERISTICS OF SOILS IDENTIFIED ALONG MOOR SUMMIT ALTERNATIVE ACCESS ROAD ROUTE

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Cobre-Enko Assoc. (#385): Gently to strongly sloping, well-drained soils on alluvial fan piedmont remnants and inset alluvial fans.	6	Cobre-60%	SIL	4-15	Slight	Moderate	Fair	Moderate	Moderate
		Enko-25%	FSL	2-8	Slight	Slight	Fair-stones, thin, arid	Moderate	Slight
Cobre Variant-Hundraw Aridic Argixerolls Assoc. (#382): Gently to strongly sloping, shallow, well-drained soils; on hills.	3	Cobre Variant-50%	SIL	4-15	Slight	Moderate	Fair-thin, arid	Moderate	Moderate
		Hundraw-15%	GR-FSL	4-15	Slight	Moderate	Poor-shallow, stones, arid	Moderate	Moderate-shallow
		Aridic Argixerolls	SIL	2-8	Slight	Slight	Fair-thin, arid	Moderate-shallow	Moderate-shallow
Enko-Chiara-Kelk Assoc. (#171): Gently to strongly sloping, well-drained soils; on slopes, summits of alluvial fan piedmont remnants.	4	Enko-40%	FSL	4-15	Slight	Moderate	Fair, stones, thin, arid	Moderate-slope, frost	Moderate slope
		Chiara-30%	SIL	2-4	Slight	Slight	Poor-arid, cemented pan*	Severe-pan*	Severe-cemented pan*
		Kelk-15%	SIL	0-2	Slight	Slight	Fair-Good	Severe-low strength*	Slight

Table 2-5. CHARACTERISTICS OF SOILS IDENTIFIED ALONG MOOR SUMMIT ALTERNATIVE ACCESS ROAD ROUTE (continued)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Tecomar-Hopeka-Ekim Assoc. (#3019): Moderately sloping to steep, shallow, well-drained soils on low mountains and hills	1	Tecomar-40%	CBX-SIL	30-50*	Slight	High*	Poor-droughty, shallow, stones, slope*	Severe-shallow, stones slope*	Severe-shallow stones, slope*
		Hopeka-25%	GRV-L	30-50*	Slight	High*	Poor-shallow, slope*	Severe-shallow, slope*	Severe-shallow, slope*
		Ekim-20%	GR-SIL	30-50*	Slight	High*	Fair to Poor-droughty, stones, slope	Severe-slope*	Severe-shallow, slope*
Dewar-Gochea Assoc. (#137): Gently to strongly sloping, well-drained, shallow to deep soils; on summits and slopes of alluvial fan piedmont remnants	18	Dewar-55%	GR-SIL	2-4	Slight	Slight	Poor-droughty, pan, stones*	Severe-pan*	Severe-cemented pan*
		Gochea-35%	L	2-8	Slight	Slight	Good to Poor-poor topsoil, stones, but good seeding	Moderate-frost	Severe-cutbanks cave*
Crooked Creek-Drained-Crooked Creek-Welch Assoc. (#211): Level to nearly level, very deep, well-drained (drainage) to poorly-drained soils; on floodplains	1	Crooked Creek-Drained-30%	SICL	0-2	Slight	Slight	Good to Poor-poor topsoil, but good seeding	Severe-low strength, high shrink/swell*	Moderate-clay, wetness
		Crooked Creek-30%	SIL	0-2	Slight	Slight	Good to Poor-poor topsoil, but good seeding	Severe-low strength, frost*	Severe-wetness*
		Welch-25%	SICL	0-2	Slight	Slight	Good to Fair	Severe-low strength, frost*	Moderate-wetness

Table 2-5. CHARACTERISTICS OF SOILS IDENTIFIED ALONG MOOR SUMMIT ALTERNATIVE ACCESS ROAD ROUTE (continued)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Wicup-Gochea-Gumble Assoc. (#4002): Gently sloping to steep, shallow to deep, well-drained soils; on hills, alluvial fans.	21	Wicup-45%	SICL	4-15	Slight	Moderate	Good to Poor-poor topsoil, but good seeding	Severe-low strength, high shrink/swell*	Moderate
		Gochea-30%	L	2-8	Slight	Slight	Good to Poor-poor topsoil, but good seeding	Moderate-frost	Severe-cutbanks cave*
		Gumble-15%	GR-SL	2-8	Slight	Slight	Poor-droughty, shallow, stones*	Severe-high shrink/swell, low strength*	Severe-shallow
Gumble-Shalper-Izar Assoc. (#240): Moderately sloping to steep, shallow to deep, well-drained soils on hills, alluvial fans.	3	Gumble-30%	GR-SL	4-15	Slight	Slight	Poor-droughty, shallow, stones, clay*	Severe-low strength, high shrink/swell*	Severe-shallow*
		Shalper-30%	GRV-L	8-30	Slight	Slight	Poor-droughty, shallow, stones, clay, slope*	Severe-shallow, slope*	Severe-shallow, slope*
		Izar-25%	GRV-L	8-30	Slight	Moderate	Poor-droughty, shallow, stones, clay, slope*	Severe-shallow, slope*	Severe-shallow, slope*
Peeko-Chiara Assoc. (#127): Gently sloping to moderately steep; shallow to cemented pan, well-drained soils on alluvial fan piedmont remnants	10	Peeko-50%	SIL	2-8	Slight	Slight	Poor-arid, pan, stones*	Severe-pan*	Severe-pan*
		Chiara-35%	SIL	2-8	Slight	Moderate	Fair to Poor pan, arid*	Severe-pan*	Severe-pan*

Table 2-5. CHARACTERISTICS OF SOILS IDENTIFIED ALONG MOOR SUMMIT ALTERNATIVE ACCESS ROAD ROUTE (concluded)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Kelk-Sonoma Assoc. (#580): Level to gently sloping, well-drained soils; on alluvial fan skirts, inset alluvial fans, and narrow floodplains	2	Kelk-70%	SIL	0-2	Slight	Slight	Fair-Good	Severe-low strength*	Slight
		Sonoma-20%	SIL	0-2	Slight	Slight	Fair-Good	Severe-low strength, frost*	Slight
Wiffo-Nevador Assoc. (#175): Gently to sloping well-drained soils; on alluvial fan skirts	15	Wiffo-50%	GRV-L	2-8	Slight	Slight	Poor - Droughty, stones, poor topsoil*	Moderate-frost action, large stones	Severe-cutbanks cave*
		Nevador-35%	L	2-8	Slight	Slight	Fair to Poor-arid stones*	Moderate-frost action	Severe-cutbanks cave*
Chiara-Dowar-Enko Assoc. (#144): Gently sloping, shallow to cemented pan, well-drained soils on alluvial fan piedmont remnants	9	Chiara-35%	SIL	2-4	Slight	Moderate	Fair to Poor pan, arid*	Severe-pan*	Severe-pan*
		Dewar-25%	GR-SIL	2-4	Slight	Slight	Poor-pan, stones, droughty*	Severe-pan*	Severe-pan*
		Enko-25%	FSL	2-4	Slight	Slight	Fair	Moderate	Slight
Toano-Tulase Assoc. (#2081): Level to gently sloping, deep, generally well-drained soils; on stream terraces, inset alluvial fans and their margins	7	Toano-55%	SIL	0-2	Slight	Slight	Fair to Poor-thin, arid soils, crusty*	Moderate	Slight
		Tulase-30%	VFSL	0-2	Slight	Slight	Fair - arid	Moderate	Slight

Table 2-6. CHARACTERISTICS OF SOILS IDENTIFIED ALONG BRUSH CREEK ALTERNATIVE ACCESS ROAD

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Dewar-Chiara-Hunnton Assoc. (#133): Gently to strongly sloping, well-drained soils, shallow to cemented pan on alluvial fan piedmont remnants	19	Dewar-40%	GR-SIL	2-8	Slight	Slight	Poor-pan, stones droughty*	Severe-pan*	Severe-pan*
		Chiara-30%	SIL	2-8	Slight	Moderate	Fair-poor-pan, stones, arid*	Severe-pan*	Severe-pan*
		Hunnton-15%	GR-L	2-8	Slight	Slight	Fair-poor-stones, arid*	Severe-low, strong, shrink/ swell*	Severe-pan cutbanks-cave*
Sonoma-Devilsgait-Sonoma, Occas. Flooded Assoc. (#182): Level to nearly level, very deep, poorly to well-drained soils, on floodplains	1	Sonoma-40%	SICL	0-2	Slight	Slight	Fair-excess salt, clayey	Severe-low strength, flooding,frost*	Severe-wetness*
		Devilsgait-25%	SIL	0-2	Slight	Slight	Poor-good-good seeding, poor topsoil	Severe-low strength, flooding*	Severe-cutbanks, cave wetness*
		Sonoma, Occas. Flooded-20%	SIL	0-2	Slight	Slight	Poor-fair-excess salts*	Severe-low strength, flooding, frost*	Moderate-wetness

Table 2-6. CHARACTERISTICS OF SOILS IDENTIFIED ALONG BRUSH CREEK ALTERNATIVE ACCESS ROAD (continued)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Jericho-Peeko-Izar Assoc. (#760): Moderately sloping to steep, shallow, well-drained soils on fan piedmont remnants and low hills	3	Jericho-40%	GR-SL	2-8	Slight	Slight	Poor-arid, cemented pan, small stones*	Severe-cemented pan*	Severe-cemented pan*
		Peeko-25%	SIL	2-8	Slight	Slight	Poor-arid, cemented pan, small stones*	Severe-cemented pan*	Severe-cemented pan*
		Izar-20%	GRV-L	15-50*	Slight	Moderate	Poor-droughty, stony, depth to rock, slope*	Severe-depth to rock, slope*	Severe-depth to rock, slope*
Valmy-Enko Assoc. (#590): Gently to strongly sloping, well-drained soils; on alluvial fan skirts adjacent to both flood-plains and alluvial fan piedmonts	12	Valmy-55%	FSL	0-2	Slight	Slight	Poor-stones, crusty*	Moderate-frost action	Severe-cutbanks cave*
		Enko-30%	FSL	2-4	Slight	Slight	Fair-stones, arid	Moderate-frost action	Slight
Hundraw-Hundraw-Eroded Assoc. (#941): Gently sloping to steep, shallow to mod. deep well-drained soils; on hills, sideslopes	16 (much of this follows existing road)	Hundraw-65%	GR-L	4-30	Slight	Moderate	Poor-depth to rock, stones, arid*	Severe-slope*	Severe-depth to rock, slope*
		Hundraw-Eroded-20%	GR-FSL	8-30	Slight	Moderate	Poor-depth to rock, stones, arid*	Severe-slope*	Severe-depth to rock, slope*

Table 2-6. CHARACTERISTICS OF SOILS IDENTIFIED ALONG BRUSH CREEK ALTERNATIVE ACCESS ROAD (concluded)

Soil Mapping Unit	Approximate % of Route[a]	Soil Series	Texture[b]	Slope (%)[c]	Wind Erosion Potential[d]	Water Erosion Potential[d]	Reclamation Potential[e]	Road Building Problems[f]	Construction/ Excavation Problems[g]
Peeko-Oupico-Dewar Assoc. (#123): Gently to strongly sloping, well-drained soils; on crests and slopes of alluvial fan piedmont remnants	13	Peeko-50%	SIL	2-8	Slight	Moderate	Poor-arid, cemented pan, stones*	Severe-cemented pan*	Severe-cemented pan*
		Oupico-20%	L	2-8	Slight	Slight	Fair-poor-arid, stones*	Moderate-pan, frost	Severe-pan*
		Dewar-15%	GR-SIL	2-4	Slight	Slight	Poor-droughty, pans, stones*	Severe-pan*	Severe-pan*
Toano-Tulase Assoc. (#2081): Level to gently sloping, deep generally well-drained soils; on stream terraces, inset alluvial fans, and their margins	5	Toano-55%	SIL	0-2	Slight	Slight	Fair-poor-thin, arid soils, crusty*	Moderate	Slight
		Tulase-30%	VFSL	0-2	Slight	Slight	Fair-arid	Moderate	Slight
Wiffo-Nevador Assoc. (#175): Gently to strongly sloping, well-drained soils; on alluvial fan skirts	31	Wiffo-50%	GRV-L	2-8	Slight	Slight	Poor-droughty, stones, poor topsoil*	Moderate frost action, large stones	Severe-cutbanks cave*
		Nevador-35%	L	2-8	Slight	Slight	Fair-poor-arid stones*	Moderate frost action	Severe-cutbanks cave*

a This figure represents an approximate percentage of the route occurring in this soil type, based on an approximate centerline location within a larger corridor.

b Soil Textures:

SIL = silt loam
GR-SIL = gravelly silt loam
GR-L = gravelly loam
GRV-SIL = very gravelly silt loam
FSL = fine sandy loam
GR-FSL = gravelly fine sandy loam
CBX-SIL = extremely cobbley silt loam
GRV-L = very gravelly loam
L = loam
SICL = silty clay loam
GR-SL = gravelly sandy loam
STX-SIL = extremely stony silt loam
STX-L = extremely stony loam
GRV-FSL = very gravelly fine sandy loam
SL = sandy loam
VFSL = very fine sandy loam

c Slopes listed are for soil series as a whole and may not be indicative of the actual terrain traversed.

d Based on SCS interpretations presented in soil series descriptions.

e Based on SCS ratings of suitability/limitations for range seeding and topsoil, as presented in soil series descriptions.

f Based on SCS ratings of suitability/limitations for construction of local roads and streets, as presented in soil series descriptions.

g Based on SCS ratings of suitability/limitations for shallow excavations, as presented in soil series descriptions.

h Average can be calculated only for the 1300 acres located within fence, as depicted on conceptual plot plan. Solid waste landfill locations are generally depicted to the southeast and to the north of the fenced area, but have not yet been finalized. Landfill average is estimated at an additional 535 acres.

* Indicates significant impact potential:

- Slope - "J40%" (corresponds to a threshold level above which cut and fill operations result in excessive instability, soil loss, problems with reclamation, etc,; would result in impacts above and beyond those impacts already accounted for in other categories).
- Wind/Water Erosion Potential - "High:
- Reclamation Potential - "Poor" or "Fair to Poor"
- Road Building Problems - "Severe"
- Construction/Excavation Problems - "Severe"

3.0 ENVIRONMENTAL CONSEQUENCES

For the purposes of assessing impacts of the land acquisition (land exchange), a general comparison was made between the types and amounts of soils which would be acquired by the BLM (offered lands) and the types and amounts of soils which the BLM would give to the applicant (selected lands). Some of the selected lands are proposed to be used for various project facilities; impacts associated with this use are discussed separately under the Construction and Operation sections. To assess impacts relating to the construction and operation of the facility and its ancillary facilities, criteria were established to identify those soil characteristics which indicate the potential for significant impacts and/or the need for special or more costly design, in the case of road-building and construction limitations. These criteria, which coincide with the categories listed in Tables 2-1 through 2-6, are:

- Slopes greater than or equal to 40 percent
- "High" wind or water erosion potential
- "Poor" or "poor - fair" reclamation potential
- "Severe" road-building problem potential
- "Severe" construction/excavation problem potential

Asterisks (*) in Tables 2-1 through 2-6 indicate where these criteria have been met by any of the soil series descriptions for the soil association in question.

3.1 LAND ACQUISITION

3.1.1 Proposed Action

Under the proposed action, approximately 12,774 acres of primarily mountain and piedmont soils would come under public domain. These soils are generally extremely steep and have characteristics that make them sensitive to disturbance (poor reclamation potential) and susceptible to erosion. Placing these lands under the public domain would put them under federal control and management, lessen the chance of disturbance by private entities, and have an overall positive impact. Acquisition of these lands would allow the BLM to manage a greater portion of these sensitive watersheds, thereby increasing the effectiveness of management toward their improvement.

The lands (15,962 acres) which would be given to the applicant also contain soils with characteristics which make them sensitive to disturbance. However, in general, they are not as shallow or steep as the Snake

Mountain Range soils. Removing these lands from the public domain would eliminate federal control of their use and could result in private use of the land which has adverse impacts upon the soils (e.g., the proposed project site and right-of-way for various utility corridors). However, the overall effect of the land acquisition and land exchange is expected to be positive, because it provides for the acquisition of a relatively large, contiguous area of very steep, sensitive mountain soils by the BLM.

3.1.2 Alternatives

3.1.2.1 Right-of-Way Grant. Under this alternative, the applicant would negotiate a right-of-way agreement for use of those public lands needed for the proposed power plant site and associated utility corridor rights-of-way. The implementation of this alternative would result in actual disturbance to soils in those areas which fall within the rights-of-way or on the plant site itself (as discussed under Construction and/or Operation sections below). This alternative offers no compensatory lands to the public in exchange and, therefore, has a less positive effect than that of the proposed action.

3.1.2.2 Selling the Public Lands. Under this alternative, the applicant would purchase public lands needed for the proposed plant and associated ancillary facilities. This would result in similar soil disturbances and impacts to those discussed under the Right-of-Way Grants alternative. However, with this alternative, funds paid for the public lands could be used to purchase additional public lands in other areas, which would serve as a form of compensation. However, for this alternative to be at least equal to the proposed action in positive impact, the selling price would have to be at least equal to the market value of the proposed offered land in the Snake River Range.

3.1.2.3 No Action. This alternative would maintain soil resources as they presently exist.

3.1.3 Mitigation

No mitigation is proposed for the proposed land acquisition action, since this action would not result in direct or significant adverse impacts to soil resources. Mitigation measures which specifically address the impacts of construction or operation on the land acquired under this proposed option are discussed under the following sections.

3.2 CONSTRUCTION

3.2.1 Proposed Action

Construction of the power plant and ancillary facilities would disturb and alter natural soil characteristics and, in some cases, result in the permanent loss of some soil material. Direct impacts to soil potentially include:

- Loss of soil pedogenic development, including soil structure and layering
- Mixing of topsoil and subsoil/substrate
- Compaction of soil by heavy equipment
- Soil loss due to increased rates of erosion caused by disturbance or exposure of soils in cuts
- Reduction of soil productivity

These direct impacts to the soil resource would affect soil stability and soil suitability as a plant growth medium. The degree of susceptibility to these impacts varies with the construction activity, topography, and soil characteristics. The degree of impacts would be greater for those soil characteristics indicated with an asterisk in Tables 2-1 through 2-6. These characteristics meet or exceed the significance criteria established: extremely steep slopes; poor reclamation potential (poor topsoil conditions, poor seeding potential); high water or wind erosion potential; and high potential for road-building or construction/excavation problems (ranked as "severe" for these problems by the SCS). A discussion of the individual facilities proposed and their associated soil impacts is provided below.

3.2.1.1 Proposed Plant Site. The construction of the proposed power plant facilities would involve site clearing, grading, possible cut and fill activity, surfacing, excavation, and ultimately construction of various building, storage areas, and waste disposal ponds and landfills. Approximately 1780 acres of soil would be lost or altered due to these activities. Essentially, the natural soils would be removed or replaced by the structures, roads, and other facilities proposed, including 540 acres designated for solid waste disposal areas. Most of the soil which would be affected (1077 acres within the fenced area and much of the expected landfill site location) consists of Wiffo-Nevador Association soils, which present severe construction/excavation problems due to cutbank instability. Some Toano series floodplain soils would also be directly impacted (150 acres within the fenced area and an undetermined additional area within the landfill site); this soil type presents no severe construction problems. Most of the soil covering the 1240-acre project site would be lost due to placement of structures and other facilities, and the remainder of the site's soils would be altered or impacted by construction activities.

3.2.1.2 Access Road. Construction of the proposed access road would involve clearing, grading, possible cut and fill activity in sloped areas, and the spreading of an asphalt surface material on the roadbed. The proposed road is approximately 14 miles long; however, approximately 4 miles would follow an existing county road and would not require new construction activity. The remaining approximately 10 miles would require all new construction activity and would cross soil types with significant reclamation, construction, and/or road-building limitations. In fact, all soil areas which would be traversed by the proposed new construction exhibit poor reclamation potential. Although the Valmy and Toano floodplain soils have somewhat better topsoil conditions, at least one soil series within these associations has a "poor" reclamation ranking. In addition, soils on the proposed access road route present severe road-building problems (hardpan, wetness, low strength) and limitations to construction/excavation (cutbank instability, cemented pan). None of the soils along the proposed access road route present problems with high erosion or extremely steep slopes.

Soils located within the actual roadbed limits (paving and shoulder) would be permanently lost. The remaining disturbed soils within the construction corridor would be affected by the compaction of construction equipment and disturbed by clearing and grading activities. Because these soils exhibit characteristics that make both reclamation and construction very difficult, it is expected that impacts would be significant and possibly long-term, if reclamation is not successful.

3.2.1.3 Railroad. The construction of the proposed railroad would involve clearing, grading, cut and fill along sloped areas, and the laying of the railroad bed and tracks, resulting in the loss of soil in the railroad bed area itself and disturbance to surrounding soil within the construction corridor (approximately 14 miles in length). All of the soil associations along the proposed railroad corridor meet the significance criteria of poor reclamation potential and severe construction constraints (especially hardpan and cutbank instability), with the exception of the Toano series and Wiffo-Nevador soils. These latter two soils, which comprise approximately 26 percent of the route, also have poor reclamation characteristics, but exhibit only slight to moderate construction or road-building constraints. A small portion (17 percent) of this route crosses a Hundraw-series soil, which could present extremely steep slopes (up to 50 percent) that can exacerbate existing topsoil and construction limitations and result in an increased impact to the soil resources of that area.

3.2.1.4 Water Pipeline. Construction of the water pipeline facility would involve excavation and removal of soil and substrate, laying of the pipeline, and backfilling of the trench. This route, approximately 18 miles long, generally follows Twentyone Mile Draw, which contains Toano-series floodplain soils. These soils, which comprise approximately 40 percent of the route, present no severe construction constraints and have a relatively fair topsoil condition in comparison to other soil types, although some thin, arid, crusty, or salty conditions could exist. Overall, the soils

along this route contain soil series which exhibit poor reclamation potential and present severe road-building and construction/excavation problems except for the Toano-Series and Wiffo-Nevador Association soils, which present "moderate" road-building problems. A small portion of this route (approximately 2 percent) consists of a Tocomar series soil association which could have extremely steep slopes, a high water erosion potential, poor reclamation potential, and possible excavation problems. In this area, the potential for increased soil loss due to erosion and minimal reclamation success could be expected.

Because the water pipeline would not require paving or surfacing of the ground, there is potential for restoration of the soils returned to the trench. However, the soils in the corridor would not lend themselves easily to reclamation operations because of their poor topsoil and reseeding potential. Therefore, the impacts could still be significant and relatively long-term, even though there would be no direct loss of soil due to placement of structures or facilities on the ground surface.

3.2.2 Alternatives

3.2.2.1 Moor Summit Access Road. Construction of this alternative access road would involve the same activities as discussed for the proposed access road. However, potential impacts to soil resources would be greater, primarily because of its total length of new construction--24 miles compared to 10 miles of new construction for the proposed road. Many of the soils along the alternative route (Dewar, Gochea, Peeko) have a cemented hardpan, which results in these soils being classified as having severe constraints to construction and road building. There would also be problems with cutbank stability and poor topsoil conditions along this route. Although a few areas are ranked "good" in their rangeland seeding potential, their topsoil is considered poor.

Overall, approximately 70 percent of the soil associations found along this route would involve significant reclamation-related impact potential, while approximately 67 percent of these soils exhibit significant construction or slope-related impact potential. These characteristics, plus the additional length of this alternative, would result in a higher negative impact than that expected from construction of the proposed access road.

3.2.2.2 Brush Creek Access Road. Construction of this access road would also involve the same activities as discussed for the proposed access road, and it is approximately the same length (about 14 miles). All 14 miles of this alignment, however, are proposed as new construction, although a portion does follow along an existing county road. About one-third of the soils along this route (Dewar, Peeko) have a cemented hardpan, and are arid and stony. Another large potion, approximately one-half of the route, consists of Wiffo-Nevador and Valmy-Enko soils, which are also stony and arid or droughty. The Hundraw Association (approximately 16 percent of the route) may present some slopes and has a shallow depth to rock. A few small segments pass over stream floodplains, which are generally better soils, although the Sonoma Association in Brush Creek Valley is known for flooding and excess salts.

Overall, approximately 94 percent of the soil associations found along this alternative route would involve significant reclamation-related impact potential, primarily due to aridity, stoniness, crusty and salty conditions, and the presence of a hardpan. Approximately 83 percent of the route's soils exhibit significant construction/slope-related constraints. The proposed access road exhibits similar problems and constraints. Because the Brush Creek Alignment is all new construction and does not utilize any existing roads, it is expected to have a slightly higher impact and/or additional or more costly design and mitigation planning.

3.2.2.3 No Action. Under the no action alternative, the project and ancillary facilities would not be constructed, and therefore there would be no significant impacts to soil resources.

3.2.3 Mitigation

A reclamation plan should be developed on a site-specific basis, after the exact locations and alignments of the various facilities are determined. The following activities should be considered as potential means for lessening erosion and soil loss and for restoring natural vegetation cover in disturbed areas:

- Limit the extent of clearing, grading, and other soil-disturbing activities. Conduct such activities only in those areas that are to be built upon, to be used during construction, or to be required to provide suitable access for construction and maintenance equipment. In addition, limit "blading" of dirt access roads if no clearing of vegetation is needed to allow passage of vehicles.

- Clear just prior to construction activity to lessen time of bare-soil exposure.

- Regrade disturbed soils to preserve or restore natural drainage patterns.

- Attempt to avoid steeply sloped areas and soils with high erosion potential when determining the exact alignments of railroad beds, access roads, and transmission lines. Otherwise, cross these areas parallel to and at the base of the slope.

- Utilize erosion controls during construction activities.

- Span small streams and floodplains containing soils with cutbank instability characteristics (for transmission lines only).

- Store and replace topsoil and reseed areas to reestablish natural cover to minimize long-term soil impacts.

- Monitor disturbed areas to determine success of mitigation measures and identify those areas requiring restabilization.

3.3 OPERATION

3.3.1 Proposed Action

No significant impacts to soil resources would be expected during the operation phase of the project. Minimal disturbance from periodic truck use could occur along the access roads (unpaved) for ancillary facilities during maintenance operations, which could increase erosion on a localized basis. Other operational activities would take place on soils that would have already been impacted (covered, removed) by the construction activities described in the previous section.

3.3.2 Alternatives

Alternatives to the proposed operational activities would not cause any additional significant effects than those expected under the proposed operational action. The no action alternative would only reduce the minimal impacts expected from transmission-line access-road maintenance and would result in no significant reduction of operations-related impacts.

3.3.3 Mitigation

No mitigation is recommended for operational activities, since no significant impacts have been identified.